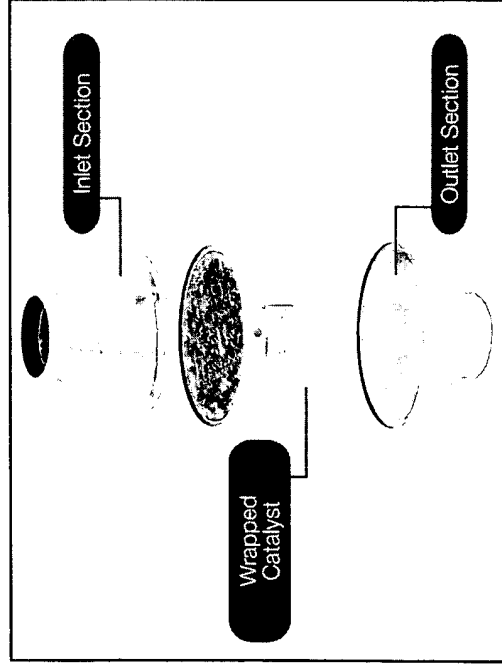


# Engine Control Systems

## AZ Purifier™/AZ Purimuffler™ Diesel Oxidation Catalyst



*Visuals courtesy of The Lubrizol Corporation*

The Lubrizol Engine Control Systems' (ECS) AZ Purifier and AZ Purimuffler are devices that either replace a diesel-powered vehicle's original muffler or work in combination with the existing muffler. The AZ Purifier is a diesel oxidation catalyst that consists of three sections that are either clamped or welded together (above). The AZ Purimuffler has the same basic configuration as the AZ Purifier but is built as purifier-and-muffler-in-one design to reduce sound pollution in addition to exhaust emissions.



*Visuals courtesy of The Lubrizol Corporation*

The volatile organic compounds of exhaust, carbon monoxide and odor-causing hydrocarbon are transformed into harmless carbon dioxide and water vapors as exhaust flows through the ceramic center body of the Lubrizol ECS AZ technology (above). The soot-forming particulate matter, or black smoke, is adsorbed onto the walls of the oxidation catalyst. The EPA has verified the emissions reductions of HC by 70%, CO by 40% and PM by 40%. The AZ DOC has the highest EPA verified PM reduction currently listed by a diesel oxidation catalyst.

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*Engine Control Systems*

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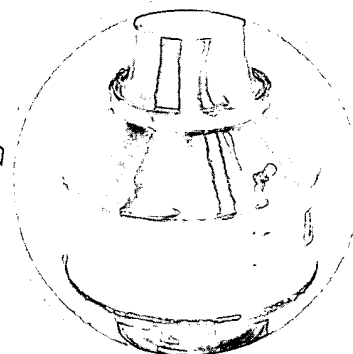
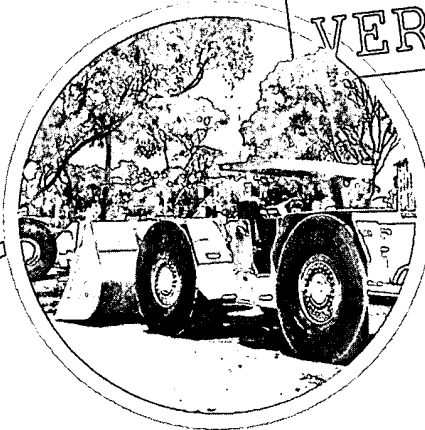
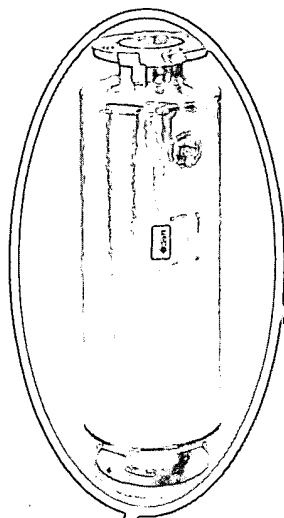
# LUBRIZOL

Engine Control Systems

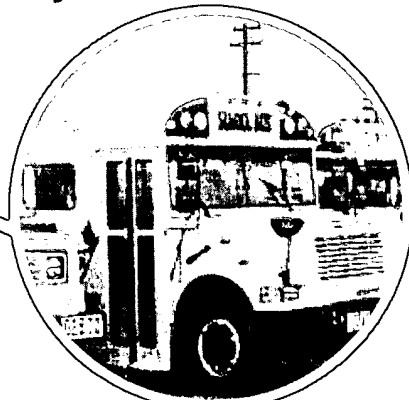
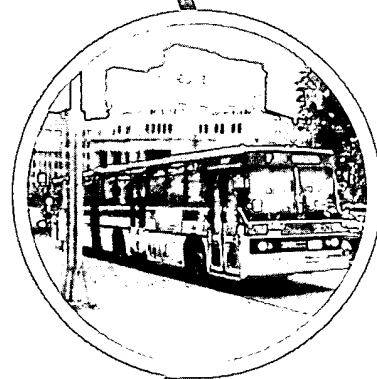
## AZ Purifiers™ and Purimufflers™

Diesel Oxidation Catalysts

VERIFIED PRODUCT



Mining  
Earth Moving  
Construction  
Heavy Industrial  
Urban Buses  
School Buses  
Highway Trucks



**AZ Purifiers and  
Purimufflers are  
now verified for  
40% PM reduction  
for on-road  
vehicles under US  
EPA verifications!**

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## What is a Diesel Oxidation Catalyst and What does it do?

Diesel Oxidation Catalyst, DOC, scrubber, purifier, catalytic converter, etc. all refer to the same product. A diesel oxidation catalyst is a coated substrate that when exhaust passes through, converts harmful compounds found in exhaust into safe elements.

Engine Control Systems designs and manufactures the diesel oxidation catalyst in both a purifier, the AZ Purifier and a muffler configuration, the AZ Purimuffler™.

The harmful elements of exhaust are both gaseous and solid in form. There are also components of exhaust that are not harmful. Below is a list of the major harmful components as well as the harmless components that are involved in the basic chemical reaction of exhaust passing through an AZ Purifier or Purimuffler.

The solid elements include:

SOF: Soluble Organic Fraction  
C: Carbon

The gaseous elements include:

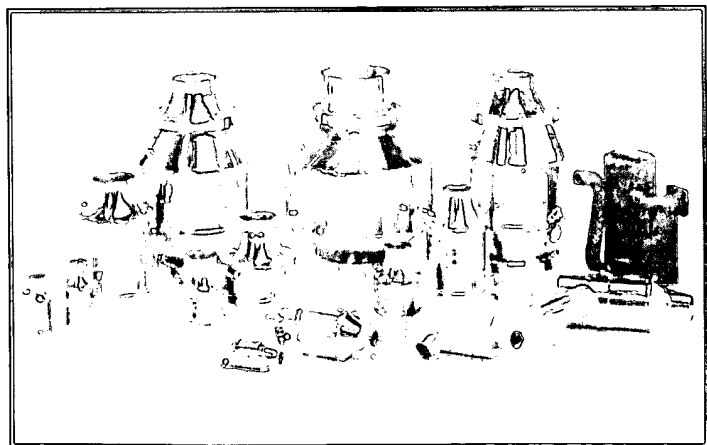
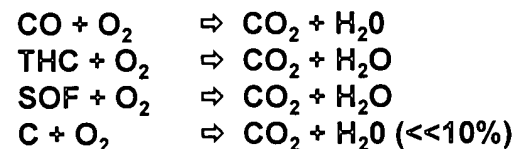
CO: Carbon Monoxide  
CO<sub>2</sub>: Carbon Dioxide  
O<sub>2</sub>: Oxygen  
THC: Total Hydrocarbons

The liquid elements include:

H<sub>2</sub>O: Water

## AZ Chemistry

Below listed are the major chemical reactions that occur within the AZ Purifier and AZ Purimuffler to change hazardous exhaust into harmless carbon dioxide and water.



## Why use an AZ Purifier™ or Purimuffler™?

AZ Purifiers and Purimufflers reduce the chance of carbon monoxide build up in enclosed work environments. They also reduce the diesel odor by reducing hydrocarbons and the soluble organics of the emitted particulate. The high SOF exhaust will result in higher TPM reductions and should decrease opacity. AZ Purifiers and Purimufflers can reduce the exposure to known diesel toxins and reduce associated health risks.

AZ products work with almost all fuel types. The catalyst will work best on lower sulfur fuels (less than 50ppm sulfur) but will also tolerate higher fuel sulfur contents (between 50 and 500ppm sulfur). AZ products can also be used with biodiesel as well as emulsified diesel fuels such as PuriNOx.

## Engine Control Systems AZ product line

Engine Control Systems AZ products consist of a Corning LFA 300 cell ceramic monolith coated with an advanced precious metal based catalyst and packaged into a stainless steel housing. The AZ family of products oxidize carbon monoxide (CO) and hydrocarbons (HC) to form harmless carbon dioxide and water (see chemical reactions to the left of the page). Engine Control Systems AZ products will also reduce the total particulate emissions by typically 25%-30% by oxidizing the soluble organic fraction of the particulate.

The AZ catalyst offers a unique zeolite containing washcoat that allows for the adsorption of PM at lower exhaust temperatures until sufficient temperature for oxidation is achieved. The superior low temperature performance of the AZ catalyst is beneficial in applications where installation 2 to 6 feet from the engine is required. Temperatures as low as 215°C are required for chemical reactivity.

AZ products do not increase toxic NO<sub>x</sub>. Unwanted chemical reactions are prevented by catalyst and washcoat formulation chemistry.

## Racor Crankcase Ventilation Filter System™

The Racor CCV Crankcase ventilation Filter Systems offer an effective solution to reduce contaminated crankcase emissions. The Racor CCV system removes crankcase emissions, providing protection for your engine and the environment.

- Keeps engine compartments and components clean
- Prevents clogging of engine intakes, turbochargers and intercoolers
- Improves reliability and of diesel engines
- More efficient than other products available on the market
- Reduces environmental pollution from crankcase emissions
- "Green" element is completely burnable and crushable
- Reduces smoke and odor in the immediate environment
- Installed as original equipment by manufacturers worldwide

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## AZ Heavy Duty Purifiers™

AZ Heavy Duty Purifiers consist of a removable catalyst center body and separate inlet and outlet cones to allow easy incorporation into a variety of exhaust pipe sizes. They are combined using machined flanges and sealing gaskets held together with quick release v-band clamps.

The AZ Heavy Duty Purifier is ideal in applications where catalyst removal is required to allow vehicle or engine maintenance, as well as engine-out smoke measurements:

- Urban buses
- School buses
- Highway trucks

The AZ Purifier is also ideal for applications where there is insufficient room for the installation of an integrated converter muffler. The AZ HD Purifier can also be combined with DMS and DMXS-II add-on silencers (see catalog).

## AZ Heavy Duty Purimufflers™

Often purifiers cannot be used due to space restrictions or exhaust backpressure limitations. For these applications, Engine Control Systems offers a wide variety of integrated catalytic mufflers. AZ Heavy Duty Purimufflers offer extremely rugged construction with equivalent or better noise attenuation and low exhaust backpressure.

## Severe Duty AZ Purifiers and Purimufflers

Often Heavy Duty is not enough, Severe Duty AZ Purifiers and Severe Duty AZ Purimuffler designs are ideal for demanding applications in:

- Mining and tunneling
- Earth moving and construction
- Power generation and heavy industrial applications

The Severe Duty AZ family integrates the AZ catalyst into an insulated double wall, heavy 14 and 16 gauge, 304 series stainless steel design. The Purimuffler option combines these features with catalytic muffler that affords 12-15 dB(A) sound attenuation and low exhaust backpressures (typically less than 20" of water).

The insulated skin serves to maximize catalyst performance while reducing external skin temperatures. This results in reduced heat radiation which can be beneficial on equipment with electronically controlled engines, hydraulic lines, or operators and other workers in close proximity. AZ Severe Duty Purifiers and Purimufflers are available with slip fit or flanged inlet / outlets.

## Why Choose the ECS AZ Product Family?

Demanding applications require products that outperform general aftermarket grade diesel purifiers. The AZ product family provides superior emissions control and sound attenuation with lower exhaust restriction over the broadest range of diesel engine applications.

Our products are tested and retested in our in-house testing facility as well as at outside testing labs. Our list of verifications, approvals, and certifications is ever changing. Talk to your customer service representative for details.

The varying quality of exhaust aftertreatment products in the marketplace is influenced by numerous factors:

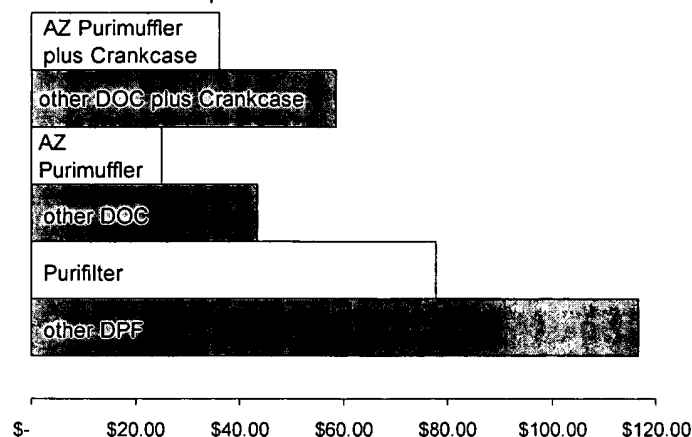
- Catalyst technology
- Design and manufacturing process,
- Facilities and people.

Engine Control Systems products are designed to offer ease of installation, peak performance, long life, and a proven service history. Each product is manufactured in an ISO 9001 or 9002 approved facility.

Engine Control Systems products have been proven over the last 20 years in the most severe conditions, including underground and open pit mining, tunneling, stationary power generation, urban and school bus routes as well as other industrial applications. Our products help to ensure air quality, productivity, and more importantly, health and safety.

## AZ Performance

Cost per % of Emissions Reduced

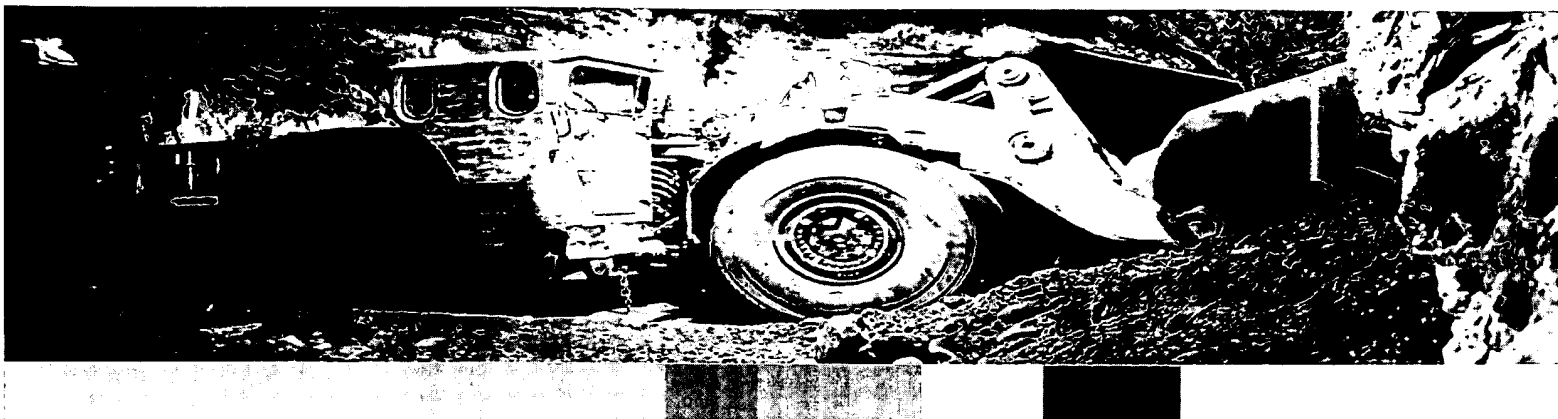


EPA Verified Results	AZ Purimuffler plus Crankcase	Other DOC plus crankcase	AZ Purimuffler	Other DOC	Purifilter	Other DPF
PM Reduction	47%*	25-33%	40%	20-26%	90%	60%
Cost without installation**	\$1700	\$1700	\$1000	\$1000	\$7000	\$7000
Cost per % PM Reduction	\$36.17	\$58.62	\$25.00	\$43.48	\$77.78	\$116.67

\*Not yet verified

\*\* Actual costs will vary depending on unit configuration and sizing

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## **AZ DOC's are a Verified Emissions Reduction Technology**

- ✓ *Verified by the California Air Resources Board*
  - ✓ *Level 1 PM reduction for off-road*
  - ✓ *Level 1 PM reduction for specific on-road vehicles*
  - ✓ *Level 2 PM reduction for off-road vehicles using PuriNOx fuel*
- ✓ *Verified under US EPA urban bus retrofit/rebuild program*
- ✓ *Certified by the US EPA Voluntary Retrofit program for two stroke and four stroke diesel engines.*
- ✓ *Verified by the US EPA for 40% PM reduction for specific on-road engines*
- ✓ *Certified by the Sweden Environmental Zones program*
- ✓ *Approved under the UK Energy Saving Trust TransportEnergy CleanUp Programme*

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